SMITHSONIAN MISCELLANEOUS COLLECTIONS.

227

ARRANGEMENT

OF THE

FAMILIES OF MOLLUSKS.

PREPARED FOR THE SMITHSONIAN INSTITUTION

BY

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ADVERTISEMENT.

THE following list has been prepared by Dr. Theodore Gill, at the request of the Smithsonian Institution, for the purpose of facilitating the arrangement and classification of the Mollusks and Shells of the National Museum; and as frequent applications for such a list have been received by the Institution, it has been thought advisable to publish it for more extended use.

JOSEPH HENRY,
Secretary S. I.

SMITHSONIAN INSTITUTION,
WASHINGTON, January, 1871

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INTRODUCTION.

OBJECTS.

THE want of a complete and consistent list of the principal subdivisions of the mollusks having been experienced for some time, and such a list being at length imperatively needed for the arrangement of the collections of the Smithsonian Institution, the present arrangement has been compiled for that purpose. It must be considered simply as a provisional list, embracing the results of the most recent and approved researches into the systematic relations and anatomy of those animals, but from which innovations and peculiar views, affecting materially the classification, have been excluded. The only merit which is claimed for it is the embodiment and co-ordination, it is hoped in a tolerably consistent form, of the taxonomic results of the information scattered through many volumes. There will doubtless be much diversity of opinion respecting the relative value of certain groups, as well as of the characters themselves whose modifications have been used for the limitations of the groups, and the author will not disguise that he himself entertains much doubt respecting certain groups and relationships preserved in the arrangement. It has seemed advisable, however, to provisionally adopt the opinions of those who have most thoroughly investigated the different groups rather than to introduce innovations based on hypothetical considerations, and which would be perhaps found to be liable to as many objections as those adopted

But although, from the very nature and extent of the subject, the present arrangement is a compilation, it nevertheless is likewise the result of researches undertaken by the author with more or less assiduity for a number of years, and, as a whole, it offers a considerable number of deviations from any classification hitherto submitted. It therefore seems proper, especially in view of the fact that this article will have a circulation among many persons who are interested in the collection and study of shells, but who have never paid especial attention to the principles of classification involved in the arrangement of the mollusks, to offer a few prefatory remarks on Taxonomy, or the science of classification, especially so far as those animals are concerned, and to answer the questions that may arise as to why some combinations are made.

PRIMARY DIVISIONS.

The classes of Mollusks are by no means allied to each other in equal degree; there are two series that differ very widely, and which have been regarded by many of the best naturalists as primary groups of the animal kingdom; that is, sub-kingdoms or branches. The great majority of the representatives of each of such groups do indeed offer so many special characteristics, and so widely differ from those of the other series, that perhaps the arguments in favor of such a view may be more weighty than those for the opposite. But the members of one class (Tunicata) seem to be in some respects intermediate or at least to narrow the chasm that would otherwise exist between the two, although their affinities are not regarded as dubious by most.

It has been found, after due investigation, that the central nervous system offers in its modifications in the Mollusks, as in the Vertebrates, the best criteria of relationship, and on the number of ganglia have been based the division thereof into the two primary groups, MOLLUSCA VERA and MOLLUSCOIDEA; in the former (*Mollusca vera*), there are three well developed pairs of ganglia—the cerebral, the pedal, and the so-called branchial (or parieto-splanchnic of Huxley)—each pair being united by commissures; in the latter (*Molluscoidea*), there is but one well developed pair, homologous with the pedal ganglia of the true Mollusks. Prof. Huxley, that very able biologist who has so much contributed by his clear mind and convincing logic to the education of the younger naturalists of the present day, has well remarked on the impossibility, or at least difficulty not yet surmounted, of the enunciation of a diagnosis which will combine the two divisions, and distinguish that combination from others.

And that difficulty has been strikingly illustrated by the positive withdrawal, by an able naturalist, of at least the Brachiopods and Bryozoans from the true Mollusks, and the combination of them with the Worms. If, then, a deviation from the example of Prof. Huxley and other masters in systematic zoology has been ventured in still retaining the combination of the two groups under the common branch name of Mollusca, it has been because there is still a certain conventional convenience in so doing, and because some members of the lower group (the Brachiopods) are almost always—at least by collectors—considered in connection with the higher forms. Another and more scientific reason is that at the confines of the lower groups, the hiatus between the two appears disproportionately little compared to that between the other branches, and a stricter series of homologies are traceable between the two. *Rhodosoma* (*Schizascus*, St.) of the Tunicates, and the recently described *Rhabdopleura*, Allmann, of the Bryozoans, are especially noticeable in this connection. It may also be added that the difficulty of framing a common diagnosis for the combined types appears to be the result of the diversity of secondary modifications and ramifications, and the extreme specialization of some forms and loss of common primitive characters, rather than of the divergence of the two types from a generalized *Proto-zoon* or aboriginal primordial stock—an element necessary to be considered in appreciation of the values of groups. In such cases, the test must be a series of consecutive inductions, and if those can be rigorously established, the truth cannot be far distant, even though an exclusive diagnosis cannot be applied. Care, however, must be taken not to abuse the privilege of combination without exact diagnosis, and the same latitude is not allowable in smaller and subordinate groups as in the more comprehensive.

CLASSES.

With regard to the classes of Mollusks, it is only necessary to state that the Pteropods have been considered as a subclass of Gasteropods, and thus retained in one and the same class with the typical members of the latter, in accordance with the views of most American malacologists, and because the hiatus between them appears to be much less than that between the Cephalopods and Gasteropods, and of course between those Odontophorous Mollusks and the Conchifers. The Pulmonifers of Cuvier—by some considered as a class apart—and the Solenoconchs—by some considered as also entitled to classic rank, by others referred to the Pteropods, and by others still to the Conchifers—have also been retained as sub-classes of the Gasteropods. The classification thus accepted is then the same as those already proposed, in 1861, by Prof. Dana[1] in his "Manual of Geology," and, in 1865, by Prof. E. S. Morse in his "Classification of the Mollusca based on the principle of cephalization." So far as the combination of the Pteropods, Heteropods, and typical Gasteropods into one class, others had also long before indicated the propriety of the innovation. The other groups regarded as of approximately equal value with those, and therefore designated sub-classes, are the Pectinibranchiates and Opisthobranchiates.

ORDERS.

Applying to the combinations of the Gasteropods into orders the principle that morphology and not teleology is the guide in natural classification, it becomes necessary to depart from some quite generally accepted schemes, and especially that whereby all the air-breathing mollusks are combined together in contradistinction from those respiring by means of branchiæ. As was perceived long ago by Cuvier, the inoperculated Pulmonifers (except *Proserpinidæ*) are entirely different from the operculated ones. That great naturalist very justly retained alone in one group the former (the *Proserpinidæ* were unknown to him), and thus constituted a truly natural order, while the operculated ones (*Cyclostomæ*, etc.) were referred to the Pectinibranchiates, and near *Littorina*, with which the best naturalists still associate them. His ignorance of the structure of the *Helicinidæ* induced him to retain them near the *Cyclostomæ*, but had he been acquainted with them, he would doubtless have combined them with his Trochoidea as they now are. The combination of all the Pulmoniferous Gasteropods into one group, as was afterwards done, was a decidedly retrograde step, and thus morphology was entirely subordinated to teleology, and even to a degree seldom equalled in recent times; for the groups enumerated are so very distinct from each other that they have no characters in common except those which they share with others as members of the same class, and the ability to breathe air direct—and even the adaptation for the latter office is affected by different modifications in the several subclasses.

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[1] Prof. Dana has only differed in the depreciation of the value of the primary groups, the *Mollusca* (his *ordinary Mollusca*) and the *Molluscoidea* (his *Anthoid Mollusca*) being considered as classes, and their subdivisions as orders.

The Heteropods, instead of representing a distinct class or subclass, are perhaps scarcely entitled to ordinal rank, but, as their distinctive characters are not entirely adaptive, they have for the present been accredited with it. Besides the *Dentalia* (SOLENOCONCHA), the *Chitonidæ* (POLYPLACOPHORA) have been removed from the association with the *Patellidæ* and *Acmaeidæ*, and for the last alone has been retained the ordinal name (DOCOGLOSSA) proposed by Dr. Troschel for all the groups mentioned. It is difficult to understand why the *Chitonidæ* have been so persistently associated with *Patellidæ*, except for the reason that after the first discovery of the homologies between the two types, the great differences between them were in a measure lost sight of—a fault common to discoverers of unexpected relationships—and that most others have since been content to accept without active thought the approximation at first suggested. The similarity of the nervous system, recently urged in justification, seems to be more superficial than real, and rather the result of adaptation to the oval depressed form common to both. Although the author has been the first to limit (in manuscript long ago prepared) the order to the families now retained in it, the ordinal name proposed by Dr. Troschel (DOCOGLOSSA) being a suggestive one, it has been preferred to a new name.[1]

It need only be added that the orders of Conchifers and of all the Molluscoids are adopted simply as appearing to be the best that have been devised, and not because they are those likely to be ultimately confirmed, at least with precisely their present limits.

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[1] Mr. W. H. Dall, after an extensive study of the anatomy of members of the group, had also arrived at the same conclusions, and was the first to demonstrate the entire want of affinity therewith of the Gadiniidæ.

FAMILIES.

The author has applied the views of those who consider those groups, above the rank of genera, combined by numerous common characters, and distinguished from neighboring groups by greater or more abrupt differences than those existing within the limits of such common associations, to be entitled to family rank. In Articulates, Vertebrates, and Radiates, such groups are often recognizable externally by a similarity of form which is dependent on more or less decided modifications of structure, or the relations between different parts. Very often, however—and especially in the Batrachians—such indications fail, and in the Mollusks there are many families that do not differ from each other in form; and, on the other hand, others exhibit a very considerable difference of form among their own representatives. Accepting the views as to the application of the term family to groups as adopted by the students of Mammals, we must apply them as we best can to the Mollusks, and of course we must be prepared for considerable diversity of views in the application, dependent on the personality of the observer, his acquaintance with the groups, and the path by which be has approached the study.

Very many, and probably most of the families now adopted, require revision based on more extensive materials than have yet been available to any one investigator. If any are to be especially pointed out in this connection, those of the orders of Cephalopods, and among the Gasteropods, the *Turbinellidæ*,[1] *Pupinidæ*, and the sub-divisions of the disintegrated *Helicidæ*, *Melaniidæ*, *Cerithacea*, and *Trochacea*, may be indicated. But, because their affinities are doubtful, they have been for the present retained, for it is believed that the evils resulting from heterogeneous combinations (not definable by diagnosis) is greater than those resulting from refinement of analysis.

The acquaintance of the author with the Polyzoa being extremely limited, he has adopted without modification the classification of Bronn (who has availed himself of all the information published up to his time), except for the Phylactolæmata, for which he has followed Prof. Hyatt, who has since thoroughly studied that order.

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[1] The *Turbinellidæ* are retained as distinct on the authority of a very distinguished naturalist, who has kindly informed me that they are "*Stromboidæ*." I have not ventured to separate them, however, farther from the *Cynodontidæ* till more is known.

The details of classification of the families are yet too unsettled to warrant the retention of the many sub-families which have been proposed, and while the necessity for the adoption of such subordinate groups is readily foreseen and admitted, so few have been characterized in a manner which could be maintained against criticism or justified by valid arguments, that only in exceptional cases have any been admitted.

GENERAL CONSIDERATIONS.

In this connection it may be remarked that there is no scientific basis for an *a priori* assumption that because the modifications of an organ are of a certain importance in one branch or class of animals, they are so in others. While such hints may perhaps be of some use, the value requires to be *verified* in each instance. Because the modifications in structure of the heart in mammals, birds, and reptiles are of primo importance, it does not follow that they are equally so in batrachians and fishes, and such a view is, indeed, opposed to facts. Still less foundation exists for the *a priori* application of such ideas to the classification of the mollusks; and their distribution into two series, distinguished by the bilocular (Monotocardian) and trilocular (Diocordian) partition of the heart, certainly seems to be opposed by the indications furnished by the sum total of the organization.

And in like manner, because the modifications of a certain part are the best indexes of affinity in one group of a class, it does not follow that even in the same class, in another group, analogous modifications are of like value. The dentition, for example, is quite characteristic in the mammalian orders Carnivores, Ungulates, and Rodents; but in the Implacentals the value of analogous modifications is very much less, and, within the range of the same order (Marsupials), superficial differences, apparently at least, as great as those between the cited orders of Placentals are found. If, therefore, the modifications of the dentition are used for the distinction of orders in one case, it is not because the dentition is the most important *per se*, but because, as a matter of fact and experience, it has been determined that the modifications thereof are the co-ordinates of corresponding, though perhaps not as readily recognizable, modifications of other parts, and being so, they are taken advantage of for diagnostic purposes.

In like manner, as a matter of experience, the groups of the Pectinibranchiate mollusks agreeing in the dentition of the radula appear to agree in other important respects, and therefore the modifications of the teeth of the radula have been made use of as the prime characters, *because* they appear to be the exponents of the sum total of structure, and until it is *shown*, by a study and co-ordination of the modifications of the entire structure, that there are other characteristics that are of more importance and better indexes of affinity, and the application has been actually made, it is not evident what other better combinations capable of demonstration and diagnosis—the true criteria—can be made. Undoubtedly we have much yet to learn concerning the affinities of all the mollusks, and undoubtedly very considerable, and perhaps fundamental, modifications of classification will be required; but, in addition to objections against a given system, suggestions for reform are at the same time desirable, and then a comparison of the respective merits of the competing systems can be instituted.

As it is evident that the differences of dentition in the Placental and Implacental mammals is of very unequal value, it is no more than might be expected that the dentition in the class of Gasteropods should also vary in value, and it is actually found that while in the Pectinibranchiates the dentition is an excellent index of affinities, it is not so in the Tectibranchiates or Nudibranchiates. In this admitted fact, however, there is no more valid argument against its value in the Pectinibranchiates than in the corresponding case in mammals.

EXTINCT FORMS.

With respect to the extinct forms, the compiler has deemed it advisable to accept the views of the most approved students of the groups as to their relations, but has felt obliged to apply to them that indefinite but generally appreciated standard of value which has been used for the living forms, and consequently the number of extinct families admitted is larger than is generally recognized, especially in the class of Cephalopods. The views of M. Barrande have been implicitly accepted in the arrangement of the families of Tetrabranchintes, save as to the value of the groups. M. Barrande has designated the Mollusca as a *class*, the Cephalopoda as an *order* of that class, and has subdivided the latter into three *families*, each comprising a greater or less number of *genera*. The standard of value applied by that learned naturalist is in each case, but especially in the appreciation of the major groups, very different from that almost universally current, and as the more comprehensive groups are here retained with the higher rank generally accredited to them, the genera are also raised to a more elevated rank: the views of M. Barrande concerning the range of his genera being provisionally accepted, they are each one raised to family rank, and although the author is disposed to dissent from the positions assumed by M. Barrande in respect to the affinities and extent or relative value of certain of his genera, his knowledge of those forms is so vastly inferior to that naturalist's, that he has not ventured in any case to depart from him, even when he would have simply accepted the views of others, for none have had such opportunities for study, or made such good use of them, as he. As the expediency of the extension of family rank to some of the forms may be questioned, it may be remarked that the tendency of some naturalists seems to be to even subdivide still more minutely, Prof. Agassiz and Prof. Hyatt, for example, differentiating the genus *Ammonites* of most authors into a number of *families*, and separating ordinally the "Ammonoids" from the *Nautilidæ.*

In addition to the numerous extinct types of the Cephalopods, there are undoubtedly many among the Gasteropods and Conchifers that are entitled to family rank; but in view of the inability of the author to study many of them, and of our ignorance of their relations, it has been deemed inadvisable to name them.

SYNONYMY.

In order to make known the extent of the families adopted, as well as to direct students to reliable sources of information, reference has been made to a specific authority for each family.

It has been deemed preferable, however, all other things being equal, to refer to some readily accessible and popular work. But in cases where such works do not give the limits to the families which have been indicated by the most approved researches, references are made to the monographs or other publications wherein the information is furnished. Some of the families, however, have not yet been assigned the limits which, in the opinion of the compiler, appear the most natural; in order, therefore, to indicate as nearly as possible the relative values of the respective groups, the system of notation recommended especially by the late Hugh Strickland has been adopted. When there is an exact equivalency, either as to the limits assigned by the diagnosis, or as to the contents, the sign of equality (=) is used; when the group referred to is larger than that adopted, the corresponding sign (<) is prefixed to the former; when the group referred to is smaller, the usual sign indicative thereof (>) is prefixed; and when the group referred to is entirely different, including some forms not in and excluding others retained in the group compared with it, the sign (×) is employed as a prefix.

ACKNOWLEDGMENTS.

In the appended list of authorities, and in connection with the names of the families, will be found the references to those authors who have been followed in especial cases. The compiler would also especially acknowledge his obligations to Mr. W. H. Dall for various kind offices and assistance in the preparation of this list.

ARRANGEMENT

OF

FAMILIES OF MOLLUSKS.

[Adopted provisionally by the Smithsonian Institution.]

N. B.—The Fossil Families are in Italics.

CLASS A.—CEPHALOPODA.

ORDER I.—DIBRANCHIATA.

SUB-ORDER OCTOPODA.

(*O. littorales.*)

1. Cirrhoteuthidae < Octopodidae, Ad. I, 18.
2. Octopodidae < Octopodidae, Ad. I, 18.

(*O. pelagici.*)

3. Philonexidae = Philonexidae, Ad. I, 21.
4. Argonautidae = Argonautidae, Ad. I, 23.

SUB-ORDER SEPIOPHORA.

(*Oigopsidae.*)

5. Cranchiidae { Cranchiidae, Ad. I, 26.
   Loligopsidae, Ad. I, 27.
6. Chiroteuthidae = Chiroteuthidae, Ad. I, 28.
7. Onychoteuthidae < Onychoteuthidae, Ad. I, 30.
8. Ommastrephidae < Onychoteuthidae, Ad. I, 30.

(*Myopsidae.*)

9. Loliginidae < Loliginidae, Ad. I, 35.
10. Sepiolidae < Loliginidae, Ad. I, 41.
11. Sepiidae = Sepiidae, Ad. I, 41.
12. *Belosepiidae* < Sepiidae, Chenu I, 46.
13. Spirulidae = Spirulidae, Ad. I, 44.
14. *Belopteridae* < Spirulidae, Chenu I, 51.
15. *Belemnitidae* = *Belemnitidae*, Chenu I, 46.

ORDER II.—TETRABRANCHIATA.

(*Nautiloidea.*)

*

16. *Nothoceratidae* = *Nothoceras*, Barr. II, 72.
17. *Bathmoceratidae* = *Bathmoceras*, Barr. II, 74.

*

18. *Trochoceratidae* = *Trochoceras*, Barr. II, 74.

*

19. Nautilidae = Nautilus, Barr. II. 128.
20. *Hercoceratidae* = *Hercoceras*, Barr. II, 152.
21. *Gyroceratidae* = *Gyroceras*, Barr. II, 156.
22. *Lituitidae* = *Lituites*, Barr. II, 168.
23. *Phragmoceratidae* = *Phragmoceras*, B. II, 189.
24. *Gomphoceratidae* = *Gomphoceras*, B. II, 243.
25. *Cyrtoceratidae* = *Cyrtoceras*, Chenu I, 73.
26. *Orthoceratidae* > *Orthoceras*, Chenu I, 59.

*

27. *Ascoceratidae* { *Ascoceras*, Barr. II, 334.
    Aphragmites, Barr. II, 366.
    Glossoceras, Barr. II, 372.

(*Goniatitoidea.*)

28. *Clymeniidae* = *Clymenidae*, Chenu I, 70.
29. *Goniatitidae* = *Goniatites*, Chenu I, 75.
30. *Bactritidae* = *Bactrites*, Chenu I, 77.

(*Ammonitoidea.*)

31. *Turrilitidae* { *Turrilites*, Chenu I, 95.
Helicoceras, Chenu I, 96.
Heteroceras, Chenu I, 96. }

*

32. *Ceratitidae* = *Ceratites*, Chenu I, 76.
33. *Ammonitidae* = *Ammonites*, Chenu I, 77.
34. *Scaphitidae* = *Scaphites*, Chenu I, 91.
35. *Crioceratidae* = *Crioceras*, Chenu I, 90.
36. *Ancyloceratidae* = *Ancyloceras*, Chenu I, 92.
37. *Hamitidae* = *Hamites*, Chenu I, 93.
38. *Ptychoceratidae* = *Ptychoceras*, Chenu I, 94.
39. *Hamulinidae* = *Hamulina*, Chenu I, 94.
40. *Toxoceratidae* = *Toxoceras*, Chenu I, 93.

*

41. *Baculitidae* = *Baculites*, Chenu I, 95.
42. *Baculinidae* = *Baculina*, Chenu I, 77.

CLASS B.—GASTEROPODA.

SUB-CLASS DIŒCA.

ORDER III.—PECTINIBRANCHIATA.

SUB-ORDER TOXOGLOSSA.

43. Conidae = Conoidea, Tr. 16.
44. Pleurotomidae = Pleurotomacea, Tr. II, 38.
45. Melatomidae = Clionellidae, Stm. A. J. C. 1865, 62.
46. Haliidae = Haliacea, Tr. II, 36.
47. Terebridae = Terebracea, Tr. II, 27.
48. Cancellariidae = Cancellariacea, Tr. II, 45.
49. Admetidae = Admetacea, Tr. II, 46.

SUB-ORDER RHACHIGLOSSA.

(*Typica.*)

50. Cystiscidae = Cystiscidae, Stm. A. J. C. 1865, 55.
51. Marginellidae < Marginellacea, Tr. II, 57.
52. Volutidae = Volutacea, Tr. II, 54.
    a. Volutomitrinae { Volutomitrina, Gray, 36.
    Amoriana, Gray, 35.
    b. Volutinae { Volutina, Gray, 32.
    Yetina, Gray, 32.

(*Odontoglossa.*)

53. Fasciolariidae = Fasciolariacea, Tr. II, 60.
  a. Fusinae
  b. Fasciolariinae
54. Mitridae = Mitracea, Tr. II, 66.

(*Duplohamata.*)

55. Melongenidae = Cassidulina, Tr. II, 79.
56. Buccinidae < Fusacea, Tr. II, 69.
  a. Photinae = Photina, Tr. II, 82.
  b. Buccininae = Buccinina, Tr. II, 69.
  c. Chrysodominae = Neptunina, Tr. II, 72.
57. Nassidae = Nassacea, Tr. II, 87.
  a. Cyclonassinae
  b. Nassininae
58. Cynodontidae < Fusacea, Tr. II, 69.
  a. Cynodontinae = Vasina, Tr. II, 84.
  b. Imbricariinae = Imbricariina, Tr. II, 86.
?59. Turbinellidae < Vasidae, Ad. I, 155.

(*Hamiglossa.*)

60. Turridae = Strigatellacea, Tr. II, 202.
61. Olividae = Olivacea, Tr. II, 105.
  a. Olivinae = Dactylina, Tr. II, 107.
  b. Olivellinae = Olivellina, Tr. II, 110.
  c. Ancillinae = Ancillina, Tr. II, 111.
62. Harpidae = Harpacea, Tr. II, 104.

63. Ptychatractidae = Ptychatractidae, Stm. A. J. C. 1865, 59.
64. Muricidae
  a. Muricinae = Muricea, Tr. II, 112.
  b. Purpurinae = Purpuracea, Tr. II, 124.

(*Atypoglossa.*)

65. Columbellidae = Columbellacea, Tr. II, 97.

SUB-ORDER TÆNIOGLOSSA.

GROUP ROSTRIFERA.

66. Pomatiidae = Pomatiacea, Tr. I, 65.
67. Cyclostomidae = Cyclostomacea, Tr. I, 68.
  a. Licininae = Licinea, Pfr. Pneum.
  b. Cistulinae = Cistulea, Pfr. Pneum.
  c. Cyclostominae = Cyclostomea, Pfr. Pneum.
68. Cyclophoridae = Cyclotacea, Tr. I, 66.
  a. Cyclotinae = Cyclotea, Pfr. Pneum.
  b. Cyclophorinae = Cyclophorea, Pfr. Pneum.
69. Pupinidae
  a. Pupininae = Pupinea, Pfr. Pneum.
  b. Diplommatininae Diplommatinacea, Pfr. Pneum.

*

70. Aciculidae = Aciculacea, Tr. I, 65.
71. Truncatellidae = Truncatellacea, Tr. I, 85.

*

72. Ampullariidae = Ampullariacea, Tr. I, 86.

*

73. Valvatidae = Valvatae, Tr. I, 95.

*

74. Viviparidae = Viviparidae, Gill. P. A. N. S. P. 1863, 33.
  a. Lioplacinae = Lioplaces, Gill, P. A. P. '63.
  b. Viviparinae = Vivipari, Gill, P. A. P. '63.

*

75. Assiminiidae < Assiminiidae, Ad. II, 314.
76. Rissoellidae = Rissoellidae, Ad. I, 325.
77. Pomatiopsidae = Pomatiopsinae, Stm. Hydr. 4, 29–36.
78. Rissoidae < Rissoidae, Stm. Hydr. 3.
  a. Amnicolinae = Hydrobiinae, Stm. Hydr. 5.
  b. Rissoinae = Rissoinae, Stm. Hydr. 5.
  c. Rissoininae = Rissoininae, Stm. Hydr. 5.
79. Skeneidae = Skeneinae, Stm. Hydr. 5.
80. Bythiniidae = Bythiniinae, Stm. Hydr. 5.
81. Fossaridae = Fossari, Tr. I, 153.
82. Littorinidae > Littorinae, Tr. I, 129.
  a. Lacuninae
  b. Littorininae

?

83. Pyramidellidae = Pyramidellidae, Ad. I, 228.
84. Eulimidae = Eulimidae, Ad. I, 235.
85. Styliferidae = Styliferidae, Ad. I, 238.

*

86. Ceriphasiidae = Strepomatidae, Tr'n A. J. C. 1865.
87. Melanopidae = Pachycheili, Tr. I, 113.
88. Melaniidae

a. Melaniinae = Melaniae, Tr. I, 121.
b. Tiarinae = Thiarae, Tr. I, 112.
c. Paludominae
89. Cerithiopsidae < Cerithia, Tr. I, 139.
90. Cerithiidae < Cerithiacea, Tr. I, 138.
a. Cerithiinae < Cerithia, Tr. I, 139.
b. Potamidinae = Potamides, Tr. I, 145.
91. Planaxidae < Planaxes, Tr. I, 149.
92. Caecidae = Caecidae, Cpr. P. Z. S. 1858, 413.
93. Vermetidae < Vermetacea, Mch. P. Z. S. 1861, 1862.
94. Tenagodidae < Vermetacea, Mch. P. Z. S. 1861, 1862.
95. Turritellidae = Turritellae, Tr. I, 152.

*

96. Trichotropidae = Trichotropidae, Tr. I, 164.

*

97. Hipponicidae = Hipponicidae, Tr. I, 162.
98. Capulidae < Capulacea, Tr. I, 156.
99. Calyptriidae = Calyptræidae, Gray, P. Z. S. '67. 726.

*

100. Neritopsidae = Neritopsidae, Gray 51.

*

101. Onustidae = Onustidae, Tr. I, 190.

*

102. Strombidae = Alata, Tr. I, 191.
a. Strombinae = Strombinae, Gill, A. J. C. 1870

b. Seraphyinae = Seraphyinae, Gill, A. J. C. 1870.

*

103. Aporrhaidae = Aporrhaidae, Tr. I, 199.

(*Digitiglossa.*)

104. Pediculariidae = Pediculariacea, Tr. I, 189.
105. Amphiperasidae = Amphiperasidae, Tr. I, 216.

ROSTRUM WITH INVERTIBLE TIP.

106. Cypraeidae = Cypraeacea, Tr. I, 201.
    a. Cypraeinae
    b. Pustulariinae
107. Triviidae = Triviacea, Tr. I, 214.
    a. Triviinae
    b. Eratoinae

*

108. Marseniidae = Marseniidae, Tr. I, 185.
109. Velutinidae = Velutinidae, Tr. I, 165.
110. Naticidae = Naticacea, Tr. I, 169.

GROUP PROBOSCIDIFERA.

111. Pyrulidae = Sycotypidae, Tr. I, 238.
112. Doliidae = Doliacea, Tr. I, 224.
113. Cassididae = Cassidea, Tr. I, 220.
114. Ranellidae = Ranellacea, Tr. I, 227.
115. Tritonidae = Tritoniacea, Tr. I, 231.

Sub-Order Ptenoglossa.

116. Ianthinidae = Ianthinidae, Gray, Guide, 53.
117. Solariidae = Architectonidae, Gray, Guide, 62.
118. Scalariidae = Scalariadae, Gray, Guide, 52.

Order IV.—HETEROPODA.

119. Atlantidae = Atlantacea, Tr. I, 41.
120. Carinariidae = Carinariacea, Tr. I, 42.
121. Pterotrachaeidae = Firolacea, Tr. I, 43.

Order V.—RHIPHIDOGLOSSA.

Sub-Order Podophthalma.

(*Pseudobranchia.*)

122. Hydrocaenidae = Hydrocaenacea, Tr. I, 83.
123. Stoastomidae = Stoastomidae, Chitty, P. Z. S. 1857, 162.
124. Helicinidae = Helicinacea, Tr. I, 75.
125. Proserpinidae = Proserpinacea, Tr. I, 84.

(*Neritacea.*)

126. Neritidae = Neritinidae, Gray, 136.

(*Trochacea.*)

127. Rotellidae = Rotelladae, Gray, 139.
128. Turbinidae = Turbinidae, Gray, 141.
129. Liotiidae = Liotiadae, Gray, 146.

130. Trochidae = Trochidae, Gray, 147.
131. Stomatellidae = Stomatellidae, Gray, 158.

(*Pleurotomariacea ?*)

132. Pleurotomariidae < Pleurotomaridae, Br. Kef. Th. III, 1037.
133. Scissurellidae = Scissurellidae, Gray, 160.

(*Haliotacea.*)

134. Haliotidae = Haliotidae, Gray, 161.

?

(*Macluraeacea.*)

135. *Macluraeidae* = *Maclureadae*, Cpr., Lect. 68.

Sub-Order Dicranobranchia.

(*Fissurellacea.*)

136. Fissurellidae < Fissurellidae, Gray, 162.
137. Emarginulidae < Fissurellidae, Gray, 162.

?

(*Bellerophontacea.*)

138. *Bellerophontidae* = *Bellerophontidae*, Meek, P. C. A. S., I, 9.

Order VI.—DOCOGLOSSA.

Sub-Order Proteobranchia.

139. Acmaeidae = Acmaeidae, Dall, A. J. C. 1870.
140. Patellidae = Patellidae, Dall, A. J. C. 1870.

SUB-ORDER ABRANCHIA.

141. Lepetidae = Lepetidae, Dall, A. J. C. 1869, 140.

ORDER VII.—POLYPLACOPHORA.

142. Chitonidae < Chitonidae, Gray, 177.
143. Chitonellidae < Chitonidae, Gray, 177.

SUB-CLASS PULMONIFERA.

ORDER VIII.—PULMONATA.

SUB-ORDER GEOPHILA.

(*Oculiferous tentacles invertible.*)

(*Agnatha.*)

144. Oleacinidae < Testacellea, Alb. Mart. 22.
145. Streptaxidae = Streptaxidae, Gray, A. M. N. H. VI, 1860, 268.
146. Testacellidae < Testacellea, Alb. Mart. 22.

(*Goniognatha.*)

147. Orthalicidae = Orthalicea, Alb. Mart. 209.

(*Hologoatha.*)

148. Cylindrellidae = Cylindrellidae, Cr. & F., J. C. 1870, 5.
149. Pupidae < Pupacea, Alb. Mart. 228.

150. Helicidae < Helicacea, Alb. Mart. 80.
151. Vitrinidae = Vitrinea, Alb. Mart. 43.

(*Togata.*)

152. Philomycidae = Philomycenidae, Gray, A.M.N.H. VI, 1860, 269.

(*Subnuda.*)

153. Cryptellidae = Cryptellidae, Gray, A.M.N.H. VI, 1860, 269.
154. Parmacellidae = Parmacellidae, Gray, A.M.N.H. VI, 1860, 268.

*

155. Limacidae < Limacidae, Ad. II, 217.
156. Arionidae = Arionidae, Ad. II, 227.

(*Elasmognatha.*)

157. Succinidae = Succinea, Alb. Mart. 308.
158. Janellidae = Janellidae, Ad. II, 227.

(*Oculiferous tentacles simply contractile.*)

159. Vaginulidae = Veronicellidae, Ad. II, 231.
160. Onchidiidae = Onchidiidae, Ad. II, 232.

SUB-ORDER BASOMMATOPHORA.

(*Limnophila.*)

161. Chilinidae = Chilinidae, Dall, A. L. N. Y. IX, 357, 1870.
162. Physidae = Physidae, Dall, A. L. N. Y. IX, 355, 1870.

163. Ancylidae = Ancylidae, Dall, A. L. N. Y. IX, 354, 1870.

164. Limnaeidae = Limnaeidae, Dall, A. L. N. Y. IX, 348, 1870.

*

165. Otinidae = Otininae, Ad. I, 249.

166. Auriculidae = Ellobiinae, Ad. I, 236.

(*Petrophila.*)

167. Siphonariidae = Siphonariidae, Dall, A. J. C. 1870, 8.

168. Gadiniidae = Gadiniidae, Dall, A. J. C. 1870, 30.

(*Thalassophila.*)

169. Amphibolidae = Amphibolidae, Ad. II, 268.

SUB-CLASS OPISTHOBRANCHIATA.

ORDER IX.—TECTIBRANCHIATA.

A

170. Philinidae < Philinidae, Gray, 191.

*

171. Amphyspiridae = Amphyspiradae, Gray, 194.

*

172. Ringiculidae = Ringiculidae, Meek, C. L. I. F. N. A., Cret., 16, 34.

173. Actaeonidae < Actaeonidae, Meek, Sill. J. XXXV, 84.

174. *Actaeonellidae* < *Actaeonidae*, Meek, Sill. J. XXXV, 84.

*

175. Cylichnidae = Bullinadae, Gray, 195.

*

176. Bullidae = Bullidae, Gray, 196.
177. Amplustridae = Amplustridae, Gray, 197.

*

178. Lophocercidae = Lophocercidae, Gray, 201.
179. Aplysiidae = Aplysiadae, Gray, 198.

B.

180. Runcinidae = Runcinadae, Gray, 204.

*

181. Tylodinidae = Tylodinadae, Gray, 203.
182. Umbrellidae = Umbrelladae, Gray, 204.
183. Pleurobranchiidae = Pleurobranchidae, Gray, 201.

Order X.—NUDIBRANCHIATA.

Sub-Order Pygobranchia.

184. Doridopsidae = Doridopsidae, A. & H., T. Z. S. 1864, 124.

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185. Dorididae = Dorididae, Gray, 208.
186. Onchidorididae = Onchidoridae, Gray, 206.

*

187. Goniodorididae = Goniodoridae, Gray, 211.
188. Polyceridae < Polyceradae, Gray, 213.
189. Triopidae > Triopidae, Gray, 214.
190. Ceratosomidae = Ceratosomidae, Gray, 215.

Sub-Order Polybranchia.

(*Inferobranchia.*)

191. Phyllidiidae = Phyllidiadae, Gray, 216.
192. Diphyllidiidae = Diphyllidiadae, Gray, 216.

(*Polybranchia.*)

193. Tritoniidae = Tritoniadae, Gray, 217.
194. Scyllaeidae = Scyllaeidae, Gray, 218.

(*Ceratobranchia.*)

(*Section* 1.)

(*A.*)

195. Dendronotidae = Dendronotidae, Gray, 219.
196. Heroidae = Heroidae, Gray, 221.
197. Tethyidae = Tethyadae, Gray, 219.
198. Dotoidae = Dotonidae, Gray, 222.
199. Proetonotidae = Proctonotidae, Gray, 220.
200. Glaucidae = Glaucidae, Gray, 222.

(*B.*)

201. Eolididae = Eolididae, Gray, 223.

(*Section* 2.)

202. Fionidae = Fionidae, Gray, 227.
203. Hermaeidae = Hermacidae, Gray, 227.

Sub-Order Pellibranchiata.

(*Tribe* 1.)

204. Elysiidae = Elysiadae, Gray, 228.
205. Limapontiidae = Limapontiadae, Gray, 229.

(*Tribe* 2.)

206. Phyllirrhoidae = Phyllirhoidae, Gray, 230.

?

SUB-ORDER ENTOCONCHACEA.

207. Entoconchidae = Heterosalpinx, Baur, N. A. A. L. C. XXXI.

SUB-CLASS PTEROPODA.

ORDER XI.—THECOSOMATA.

208. Limacinidae = Limacinacea, Tr. I, 50.
209. Hyalidae = Hyalacea, Tr. I, 50.
210. Cymbuliidae = Cymbuliacea, Tr. I, 53.
211. *Conulariidae* = *Conulariidae*, Br. Th. III, 645.
212. *Hyolithidae* = *Thecidae*, Br. Th. III, 646.

ORDER XII.—GYMNOSOMATA

214. Clionidae = Clionacea, Tr. I, 54.

*

215. Pneumodermonidae = Pneumodermacea, Tr. I, 56.

*

216. Cymodoceidae = Pterocymodoceidae, Br. Th. III, 645.

SUB-CLASS PROSOPOCEPHALA.

ORDER XIII.—SOLENOCONCHÆ.

217. Dentaliidae = Dentaliidae, Br. Th. III, 523.

Class C.—CONCHIFERA.

Order XIV.—DIMYARIA.

(*Pholadacea.*)

218. Aspergillidae < Gastrochaenidae, Tryon, P. A. N. S. P., 1861, 465.
219. Gastrochaenidae < Gastrochaenidae, Tryon, P. A. N. S. P., 1861, 465.
220. Teredinidae = Terediidae, Tryon, P. A. N. S. P., 1862, 453.
221. Pholadidae = Pholadidae, Tryon, P. A. N. S. P., 1862, 191.

(*Solenacea.*)

222. Solenidae < Solénacées, Desh. 1860, 143.
223. Solecurtidae < Solénacées, Desh. 1860, 143.

(*Myacea.*)

224. Saxicavidae = Glycimérides, Desh. 1860, 165.
225. Myidae < Myaires, Desh. 1860, 182.
226. Corbulidae < Myaires, Desh. 1860, 182.
227. Pandoridae = Pandoridae, Desh. 1860, 238.
228. Anatinidae < Osteodesmidae, Desh. 1860, 245.
229. Myochamidae = Myochamidae, Cpr. Lect. 103.

*

230. Pholadomyidae = Pholadomyadae, Desh. 1860, 270.

(*Veneracea.*)

231. Mactridae < Mactracea, Desh. 1860, 281.
232. Mesodesmidae = Mésodesmides, Desh. 1860, 297.
233. Amphidesmidae = Amphidesmidae, Desh. 1860, 297.

*

234. Tellinidae = Tellinidae, Desh. 1860, 314.
235. Psammobiidae = Psammobidae, Desh. 1860, 364.
236. Donacidae = Donacidae, Desh. 1860, 387.
237. Petricolidae = Lithophaga, Desh. 1860, 400.
238. Veneridae < Conchae, Desh. 1860, 407.
239. Glauconomidae = Glauconomyadae, Ad. II, 442.

(*Corbiculacea.*)

240. Cyrenidae = Cycladae, Gray, Turton, 250.
241. Pisidiidae = Pisidiidae, Gray, Turton, 263.
242. Cyrenoididae = Cyrenoididae, Ad. II, 452.

(*Dreissenacea.*)

243. Dreissenidae = Dreissenidae, Ad. II, 52.

(*Cardiacea.*)

244. Veniliidae = Cyprinidae, Ad. II, 443.
245. Glossidae < Bucardiidae Ad. II, 460.

246. Cardiidae < Cardiacea, Desh. 1860, 527.
247. Adacnidae < Cardiacea, Desh. 1860, 527.

(Chamacea.)

248. Chamidae = Chamacea, Desh. 1860, 577.

(Lucinacea.)

249. Lucinidae < Lucinidae, Desh. 1860, 588.
250. Ungulinidae < Ungulinidae, Ad. II, 470.
251. Erycinidae < Laseidae, Ad. II, 473.
252. Cyamiidae < Laseidae, Ad. II, 473.
253. Leptonidae < Leptonidae, Ad. II, 477.
254. Galeommidae < Galeommidae, Ad. II, 479.

(Solemyacea.)

255. Solemyidae = Solemyadae, Desh. 1860, 728.

(Carditacea.)

256. Crassatellidae = Crassatellidae, Desh. 1860, 733.
257. Carditidae = Carditae, Desh. 1860, 751.

(Naiades.)

258. Unionidae < Unionidae, Ad. II, 489.
259. Iridinidae = Mutelidae, Ad. II, 505.
260. Mycetopodidae = Mycetopodidae, Gray, P.Z.S., 1847, 197.

(Muelleracea.)

261. Ætheriidae < Ætheriidae, Ad. II, 509.
262. Muelleriidae < Ætheriidae, Ad. II, 509.

(Trigoniacea.)

263. Trigoniidae = Trigonea, Desh. 1860, 805.

(Arcacea.)

264. Nuculidae = Nuculidae, Ad. II, 544.
265. Ledidae = Ledidae, Ad. II, 546.
266. Arcidae = Arcacea, Desh. 1860, 832.

ORDER XV.—METARRHIPTAE.

267. Tridacnidae = Tridacnides, Vaill, A. S. N., IV, 1865, 64.

ORDER XVI.—HETEROMYARIA.

268. Mytilidae = Mytilidae, Ad. II, 511.

ORDER XVII.—MONOMYARIA.

(Aviculacea.)

269. Pinnidae = Pinnidae, Meek, Sill. J. XXXVII, 212.
270. Pteriidae = Pteriidae, Meek, Sill. J. XXXVII, 212.
271. Vulsellidae = Vulsellidae, Ad. II, 523.

(Pectinacea.)

272. Spondylidae = Spondylidae, Ad. II, 559.

273. Limidae = Radulidae, Ad. II, 556.
274. Pectinidae = Pectinidae, Ad. II, 550.

(*Anomiacea.*)

275. Placunidae = Placunidae, Carp. Lect. 123.
276. Anomiidae = Anomiadae, Carp. Lect. 123.

(*Ostracea.*)

277. Ostreidae = Ostracea, Ad. II, 567.
?
278. *Eligmidae* = *Eligmus*, Eudes Desl. M. L. S. N., X, 272.

?
ORDER XVIII.—RUDISTA.

279. *Hippuritidae* < *Hippuritidae*, Woodw. Man. 1866, 440.
280. *Radiolitidae* < *Hippuritidae*, Woodw. Man. 1866, 440.
281. *Caprinellidae* < *Hippuritidae*, Woodw. Man. 1866, 440.
282. *Caprinidae* < *Hippuritidae*, Woodw. Man. 1866, 440.
283. *Caprotinidae* < *Hippuritidae*, Woodw. Man. 1866, 440.

(Sub-Branch Molluscoidea.)

Class D.—TUNICATA.

Order XIX.—SACCOBRANCHIA.

(*Solitaria.*)

284. Pelonaeidae = Pelonaeidae, Br. III, 216.
285. Chelyosomidae < Ascidiadae, Br. III, 218.
286. Ascidiidae < Ascidiadae, Br. III, 218.
287. Bolteniidae < Ascidiadae, Br. III, 218.

*

$287^{a.}$ Rhodosomidae = Rhodosoma, Crosse, J. C. XV, 1877, 101.

(*Sociales.*)

(*S. Perophoracea.*)

288. Perophoridae < Clavellinidae, Br. III, 217.

(*S. Clavellinacea.*)

289. Clavellinidae < Clavellinidae, Br. III, 217.

(*Aggregata.*)

290. Sigillinidae < Didemninae, Br. III, 217.
$290^{a.}$ Didemnidae < Didemninae, Br. III, 217.
291. Leptoclinidae < Didemninae, Br. III, 217.

*

292. Polyclinidae < Polyclininae, Br. III, 217.
293. Synoeciidae < Polyclininae, Br. III, 217.

*

294. Botryllidae = Botryllidae, Br. III, 217.

ORDER XX.—DACTYLOBRANCHIA.

295. Pyrosomidae = Pyrosomatidae, Br. III, 216.

ORDER XXI.—TAENIOBRANCHIA.

296. Doliolidae = Doliolidae, Br. III, 216.

*

297. Salpidae = Salpidae, Br. III, 216.

ORDER XXII.—LARVALIA.

298. Appendiculariidae = Appendiculariadae, Br. III, 216.

CLASS E.—BRACHIOPODA.

ORDER XXIII.—ARTHROPOMATA.

(*Ancylopoda.*)

299. Terebratulidae < Terebratulidae, Dav. Int. 61.
   a. Terebratulinae = Terebratulinae, Dall, A. J. C. 1870.
   b. *Stringocephalinae* = *Stringocephalinae*, Dall, A. J. C. 1870.
   c. Magasinae = Magasinae, Dall, A. J. C. 1870.
   d. Kraussininae = Kraussininae, Dall, A. J. C. 1870.
   e. Platidiinae = Platidiinae, Dall, A. J. C. 1870.
   f. Megathyrinae = Megathyrinae, Dall, A. J. 1870.
300. Thecidiidae = Thecideidae, Dav. Int. 76.

(*Helictopoda.*)

301. *Spiriferidae* < *Spiriferidae*, Dav. Int. 79.
302. *Atrypidae* < *Spiriferidae*, Dav. Int. 90.
303. *Koninckinidae* = *Koninckinidae*, Dav. Int. 92.
304. Rhynchonellidae = Rhynchonellidae, Dav. Int. 93.
   a. *Pentamerinae*
   b. Rhynchonellinae

305. *Strophomenidae* = *Strophomenidae*, Dav. M. L. S. N., X, 191.
  a. *Porambonitinae* = *Porambonitidae*, Dav. Int. 99.
  b. *Strophomeninae* = *Strophomenidae*, Dav. Int. 101.
  c. *Davidsoninae* = *Davidsonidae*, Dav. Int. 109.
306. *Productidae* = *Productidae*, Dav. Int. 112.

ORDER XXIV.—LYOPOMATA.

307. Craniidae = Craniadae, Dav. Int. 123.
308. Discinidae = Discinidae, Dav. Int. 125.
309. Lingulidae = Lingulidae, Dall. A. J. C. VI, 1870.
  a. Lingulinae = Lingulinae, Dall. A. J. C. VI, 1870.
  b. *Obolinae* = *Obolinae*, Dall, A. J. C. VI, 1870.

Class F.—POLYZOA.

Order XXV.—PHYLACTOLÆMATA.

Sub-Order Lophopodia.

310. Pectinatellidae = Pectinatellidae, Hyatt, P. E. I. 1864-66.
311. Cristatellidae = Cristatellidae, Hyatt, P. E. I. 1864–66.
312. Plumatellidae = Plumatellidae, Hyatt, P. E. I. 1864–66.

Sub-Order Pedicellinea.

313. Pedicellinidae = Pedicellinidae, Bronn, III, 86.

Order XXVI.—GYMNOLÆMATA.

Sub-Order Urnatellea.

314. Urnatellidae = Urnatellidae, Bronn, III, 86.

Sub-Order Paludicellea.

315. Paludicellidae = Paludicellidae, Bronn, III, 86.

Sub-Order Chilostomata.

(*Incrustata* or *Rigida.*)

316. Selenariidae = Selenariadae, Bronn, III, 86.
317. *Steginoporidae* = *Steginoporidae,* Bronn, III, 86.

318. Eschariporidae = Eschariporidae, Bronn, III, 86.
319. Porellinidae = Porellinidae, Bronn, III, 86.
320. *Porellidae* = *Porellidae*, Bronn, III, 86.
321. Escharellidae = Escharellidae, Bronn, III, 86.
322. Escharellinidae = Escharellinidae, Bronn, III, 86.
323. Porinidae = Porinidae, Bronn, III, 86.
324. Escharinellidae = Escharinellidae, Bronn, III, 85.
325. Escharidae = Escharidae, Bronn, III, 85.
326. Flustrinidae = Flustrinidae, Bronn, III, 85.
327. Flustrellidae = Flustrellidae, Bronn, III, 85.
328. Flustrellariidae = Flustrellariadae, Bronn, III, 85.
329. Hippothoidae = Hippothoidae, Bronn, III, 84.

(*Radicellata.*)

(*Radicellata flexilia.*)

330. Gemellariidae = Gemellariadae, Bronn, III, 84.
331. Farciminariidae = Farciminariadae, Bronn, III, 84.
332. Flustridae = Flustridae, Bronn, III, 84.
333. Bicellariidae = Bicellariadae, Bronn, III, 84.
334. Electrinidae = Electrinidae, Bronn, III, 84.
335. Scrupariidae = Scrupariadae, Bronn, III, 83.

(*Radicellata articulata.*)

336. Salicornariidae = Salicornariadae, Bronn, III, 83.
337. Cellulariidae = Cellulariadae, Bronn, III, 83.
338. Catenicellidae = Catenicellidae, Bronn, III, 83.

Sub-Order Ctenostomata.

339. Hislopiidae = Hislopiadae, Bronn, III, 83.
340. Alcyonidiidae = Alcyonidiadae, Bronn, III, 83.
341. Vesiculariidae = Vesiculariadae, Bronn, III, 83.

Sub-Order Cyclostomata.

(*Articulata.*)

342. Crisiidae = Crisiadae, Bronn, III, 82.

(*Inarticulata.*)

(*Inarticulata operculata.*)

343. *Eleidae* = *Eleidae*, Bronn, III, 82.
344. Myriozoidae = Myriozoidae, Bronn, III, 82.

(*Inarticulata fasciculata.*)

345. Fascigeridae = Fascigeridae, Bronn, III, 82.
346. *Fasciporidae* = *Fasciporidae*, Bronn, III, 81.

(*Inarticulata tubulata.*)

347. Tubigeridae = Tubigeridae, Bronn, III, 81.
348. Sparsidae = Sparsidae, Bronn, III, 80.
349. Clausidae = Clausidae, Bronn, III, 80.
350. Crisinidae = Crisinidae, Bronn, III, 80.
351. Caveidae = Caveidae, Bronn, III, 79.

(*Inarticulata foraminata.*)

352. *Ceidae* = *Ceidae*, Bronn, III, 79.
353. *Cavidae* = *Cavidae*, Bronn, III, 79.
354. *Cytidae* = *Cytidae*, Bronn, III, 79.
355. *Crescidae* = *Crescidae*, Bronn, III, 79.

ORDER XXVII?—RHABDOPLEURAE.

356.	Rhabdopleuridae	= Rhabdopleura, Allm. Q. J. M. S., IX, n. s., 57.

LIST OF AUTHORS REFERRED TO.

The following enumeration of works is chiefly intended to explain the abbreviations used in connection with the preceding list of families, and as the works most accessible to students generally have been used, whenever they could be referred to in explanation of the limits of families adopted, titles of the most elaborate and valuable monographs and catalogues of families and other groups have been entirely omitted, although the compiler has been fortunate enough to be enabled to make use of them. Special monographs have only been referred to when the groups in connection with which they are cited have not been limited in the same manner in general works.

In order, however, to facilitate the use of the list, as well as reference to the series in question, Mr. Lovell Reeve's "Conchologia Iconica" has been catalogued, and all the monographs hitherto published enumerated, with references to the families to which the respective genera belong in the present system.

For the information of students, and because it is information often desired, the publishers' prices of most of the works cited are given, in the currency of the country where they were published. Many of the separate monographs reprinted from journals can be obtained from the second-hand book dealers—especially the German—and from the Naturalists' Agency of Salem, Mass., but at varying prices.

In order to secure uniformity of typography, only the initial letters of the characteristic words are capital, the example of the learned brothers Grimm, as well as other German writers, sanctioning such usage for their language. The punctuation of the respective title-pages is adopted.

ADAMS (Henry *and* Arthur). The genera of recent Mollusca; arranged according to their organization. . . . . In three volumes. . . . . Vol. I. [-] III. —— London: John Van Voorst, ... 1858. [8vo., V. I, 484 pp.; V. II, 2 p. l. 661 pp.; Atlas, 3 p. l. 138 pl. w. 138 l. opposite. Published in 36 parts, 1st Jan. 1853—1st Nov. 1858, at 2 sh. 6 d., plain; 5 sh., animals colored, per part.]

ALBERS (Johann Christian). Die Heliceen nach natürlicher verwandtschaft systematisch geordnet von Joh. Christ. Albers, ... Zweite ausgabe nach dem hinterlassenen manuskript besorgt von Eduard von Martens. —— Leipzig, Verlag von Wilhelm Engelmann. 1860. [8vo., xviii. 359 pp.—3 th. 7½ ngr.]

ALDER (Joshua) *and* Albany HANCOCK. A monograph of the British Nudibranchiate mollusca: with figures of all the species. . . . . London: Printed for the Ray Society, 1845. [Imp. 4to., 5 p. l. 54 pp. 138 l., xl pp. 1 l., 83 pl. Published in parts, 1845–55.]

[The arrangement of the Nudibranchiata is mostly adopted from Alder and Hancock (op. cit. pp. xiv.—xxiv.). In place, however, of the single family

Dorididae, two (185, 186) are adopted; four (187, 188, 189, 190) instead of the Polyceridae, and two (195, 196) disintegrated from the Heroidae.]

ALDER (Joshua) *and* **Albany HANCOCK.** Notice of a collection of Nudibranchiate mollusca made in India by Walter Elliott, Esq., with descriptions of several new genera and species. (1863.) < Transactions of the Zoological Society of London, V, 1866, 113–147, pl. 28–33.

ALLMAN (George James). On Rhabdopleura, a new form of polyzoa, from deep-sea dredging in Shetland. < Quarterly Journal of Microscopical Science: [etc.], IX, n. s., 1869, 57—63, pl. 8.

AMERICAN Journal of Conchology. Volume I. [—] II. Edited by George W. Tryon, Jr., ... Philadelphia: George W. Tryon, Jr., 625 Market Street. 1865 [—] 1866. [Published quarterly, at $3 per number, or $10 per year.]

——The same. Volume III. [—] V. Published by the Conchological section of the Academy of Natural Sciences. . . . . Philadelphia: Conchological section of the Academy of Natural Sciences. . . . . 1867 [—] 1870. [Published at $10 per annum, payable in advance.]

BARRANDE (Joachim). Caractères distinctifs des Nautilides, Goniatides et Ammonides.—Établissement du genre Nothoceras, ... < Bulletin de la Société géologique de France. 2e série. XIII, 372–389, pl. 11—12, 1856.

[The genera enumerated in this article are co-equal with and arranged in the same sequence as the families of Goniatitoidea and Ammonitoidea, which are equivalent to the families Nautilides and Goniatides of Barrande.]

—— Système silurien du centre de la Bohême . . . . 1ère partie: Recherches paléontologiques. Vol. II. Texte. Classe des mollusques. Ordre des Céphalopodes. 1867. Chez l'auteur et éditeur | à Prague . . . . à Paris, ... [4to., xxxvi, 712 pp.—40 fr.]

——The same. [Atlas.] 1ère partie: Recherches paléontologiques. Vol. II. Céphalopodes. [1ère—3me série, as below.] 1865 [–] 1868. Chez l'auteur et éditeur | à Prague, ... à Paris, ... [4to.]

1ère série: Planches 1 à 107. 1805. [100 fr.]
2me série: Planches 105 à 244. 1866. [125 fr.]
3me série: Planches 245 à 350. 1868. [140 fr.]

BAUR (Albert). Beiträge zur naturgeschichte der Synapta digitata. —— Dritte abhandlung: Die eingeweideschnecke (Helicosyriux parasita) in der leibeshöhle der Synapta digitata. . . . . Dresden. Druck von E. Blochmann & sohn. 1864. [4to., 2 p. l. 119 pp. pl. vi.—viii.] < Novorum Actorum Academiæ Cæsareæ Leopoldino-Carolinæ naturæ curiosorum XXXI. 1864.

BRONN (Heinrich Georg). Die klassen und ordnungen des Thierreichs, wissenschaftlich dargestellt in wort und bild . . . . Dritter band. Malacozoa . . . . Leipzig und Heidelberg. C. F. Winter'sche verlagshandlung, 1862–66. [Published in 48 parts, 8vo., 1862–66, at ½ th. per part, and bound in 2 vols., with double titles, general and special, viz:]

III, 1. Die klassen und ordnungen der Weichthiere (Malacozoa), wissenschaftlich dargestellt in wort und bild. Von Dr. H. G. Bronu, ... Dritten band erste abtheilung. Kopflose Weichthiere (Malacozoa Acephala). . . . . [2 titles, pp. 1–518, pl. 44, w. 44 opp. expl. l. 1802.]

III, 2. Dr. H. G. Bronn's klassen und ordnungen der Weichthiere (Malacozoa), wissenschaftlich dargestellt in wort und bild. Fortgesetzt von Wilhelm Keferstein, M. D. . . . . Dritten bandes zweite abtheilung. Kopftragende Weichthiere (Malacozoa Cephalophora). . . . . [2 titles, pp. 521–1500, pl. 45–136, w. 92 opp. expl. l. 1862–66.]

CARPENTER (Philip P . . .). First steps towards a monograph of the Cæcidæ, a family of rostriferous gasteropoda. < Proceedings of the Zoological Society of London. Part XXVI, 1858, 413—444.

——— Lectures on Mollusca; or, "shell-fish" and their allies. Prepared for the Smithsonian Institution, by Philip P. Carpenter, B. A., Ph. D., of Warrington, England. < Annual report of the board of regents of the Smithsonian Institution, . . . for . . . 1860, 1861, 151—283.

[Reprinted, with index, 140 pp., Washington, 1860.]

CHENU (Jean Charles). Manuel de conchyliologie et de paléontologie conchyliologique par le Dr. J. C. Chenu . . . . Paris | Librairie Victor Masson . . . . 1859 [–] 62. [8vo., 2 v. I, 2 p. l. vii, 508 pp.; II, 3 p. l. 327 pp. Published in 3 parts, 1859–61 @ 12.50 + 12.50 + 20 = 45 fr.; reduced now to 32 fr.]

CHITTY (Edward). On Stoastomidæ as a family, and on seven proposed new genera, sixty-one new species, and two new varieties from Jamaica. < Proceedings of the Zoological Society of London, Part XXV, 1857, pp. 162—201.

CROSSE (H . . .). Note sur un genre [Rhodosoma] intermédiare entre les ascidiens et les mollusques lamellibranches. < Journal de conchyliologie, v. XV (3e série, t. VII), 1867, 101—107.

CROSSE (H . . .) *and* **Paul FISCHER.** Étude sur la mâchoire et l'armature linguale des Cylindrellidæ et des quelques genres voisins sous la rapport conchyliologique. < Journal de conchyliologie, v. XVIII (3e séric. t. X), 1870, 5—27, pl. 3—5.

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——— Materials toward a monograph of the Gadiniidæ. < Ib. VI, 8—22, pl. 2 and 4, fig. 1—3, 12—13. 1870.

——— Remarks on the anatomy of the genus Siphonaria, with a description of a new species. < Ib. VI, 30—41, pl. 4—5. 1870.

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DAVIDSON (Thomas). Introduction à l'histoire naturelle des Brachiopodes vivants et fossiles, ou considérations générales sur la classification de ces êtres en familles et en genres; par Thomas Davidson, Esq., ... Traduit de l'Anglais par M. Eudes-Deslongchamps, . . . ; et par M. Eugene Eudes-Deslongchamps, ... <Mémoires de la Société linnéene de Normandie. X, 1856, 71—271, pl. 6—14, with 9 l. explan.

[A translation of the third part of the preceding work, with modifications by the author.]

DESHAYES (Gerard Paul). Description des animaux sans vertèbres découverts dans la bassin de Paris pour servir de supplément à la Description des coquilles fossiles des environs de Paris comprenant une revue générale de toutes les espèces actuellement connues, par G. P. Deshayes.—[See "Contents."]—— Paris, J. B. Baillière et fils, ... 1860 [—] 1866. [50 livr., chaque livr. 5 fr.]

CONTENTS.

Tome premier.—Texte. Mollusques Acéphalés Dimyaires. Accompagné d'un Atlas de 89 planches. . . . 1860. [2 p. l. 912 pp.]

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Atlas. Tome deuxième.—(107 planches.) Mollusques Céphalés et Mollusques Céphalopodes. . . . 1866. [2 p. l. 107 pp. 107 pl.]

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GILL (Theodore Nicholas). Systematic arrangement of the mollusks of the family Viviparidæ, and others, inhabiting the United States. <Proceedings of the Academy of Natural Sciences of Philadelphia, 1863, 33—40.

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GRAY (John Edward). Catalogue of the Mollusca in the collection of the British Museum. Part I. Cephalopoda Antepedia. Printed by order of the trustees. London: 1849. [12mo. viii, 164 pp.—4 sh.]

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HANCOCK (Albany). *See* **Alder (Joahna)** *and* **Hancock.**

HUXLEY (Thomas Henry). An introduction to the classification of animals. . . . . —— London: John Churchill & Sons, ... 1869. [8vo., 4 p. l. 147 pp. 6 sh.]

[Authority for the Tunicate order *Larvalia.*]

HYATT (Alpheus). Observations on Polyzoa. Suborder Phylactolæmata. <Proceedings of the Essex Institute, IV, V.

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—— Note on the affinities of the Bellerophontidæ. < Proceedings of the Chicago academy of sciences, I, 9—11, 1865.

—— Check list of the invertebrate fossils of North America. Cretaceous and Jurassic. By F. B. Meek. —— Washington: Smithsonian Institution. April, 1864. [8vo. 1 p. l. 40 pp.—25 c.] < Smithsonian miscellaneous collections. VII, 1867.

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—— Ibid. II. Supplementum primum. . . . . —— Cassellis. Sumptibus Theodori Fischer. 1858. [8vo. viii, 249 pp.—2 th.]

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—— Catalogue of Phaneropneumone, or terrestrial operculated mollusca, in the collection of the British Museum. —— Printed by order of the trustees. London, 1852. [12mo. 2 p. l. 324 pp.—5 sh.]

[A translation of the Monographia Pneumonoporum viventium (1852), with few modifications, edited by Dr. J. E. Gray.]

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—— Catalogue of Auriculidæ, Proserpinidæ, and Truncatellidæ in the collection of the British Museum. London: printed by order of the trustees. 1857. [12mo. 2 p. l. 150 pp.—1 sh. 9 d.]

[A translation of the preceding, with slight modifications, edited by Dr. J. E. Gray.]

PHILADELPHIA (Conchological Section of the Academy of Natural Sciences of). [Catalogue of recent Mollusca. Viz:—]

Catalogue of recent Mollusca, belonging to the order Pholadacea. By George W. Tryon, Jr. pp. 1—21. 1868.

Catalogue of the family Solenidæ. By T. A. Conrad. pp. 22—29. 1868.

Catalogue of the family Mactridæ. By T. A. Conrad. pp. 30—47. 1868.

Catalogue of the family Anatinidæ. By T. A. A. Conrad. pp. 49—58. 1869.

Catalogue of the families Saxicavidæ, Myidæ and Corbulidæ. By George W. Tryon, jr. pp. 59—68. 1869.

Catalogue of the family Pandoridæ. By Philip P. Carpenter. pp. 69—71. 1869.

Catalogue of the family Tellinidæ. By George W. Tryon, jr. pp. 72—126. 1869.

Catalogue of the recent species of the family Corbiculadæ. By Temple Prime. pp. 127—187. 1870.

Catalogues of the families Porcellanidæ [=Cypraeidæ+Triviidae—Eratoinæ] and Amphiperasidæ. By S. R. Roberts. pp. 189—214. 1870.

Catalogue of the known species, recent and fossil, of the family Marginellidæ [+Cystiscidæ+Eratoinæ]. By John H. Redfield. pp. 215—269. 1870.

[Although these catalogues have not actually been referred to in the Arrangement, they are here recorded on account of their usefulness as well as cognate nature.]

See, also, **AMERICAN** Journal of Conchology.

REEVE (Lovell Augustus). Conchologica iconica; or, illustrations of the shells of Molluscous animals. . . . . London: Reeve, brothers, ... 1843 [-] 1845; Reeve, Benham, and Reeve, ... 1847 [-] 1849; Reeve and Benham, . . . ; 1851; Lovell Reeve, ... 1854 [-] 1860; Lovell Reeve & co., ... 1862, [et seq.] [4to., 193 monographs in 17 volumes.]

[The following classified list of the "monographs" is given, in order to serve as an index to the volumes—a desideratum that has not been supplied by the publishers—as well as and more especially to serve as a reference from the best known generic names to the position of the families in the present arrangement, and to give some—although rather inadequate—idea of the numbers of species. It must be understood, however, that many of the "genera" enumerated in the following list are artificial assemblages of species combined on account of agreement in some more or less marked conchological character, and that some genera (e. g. *Bulimus*, *Helix*, *Lucina*, *Pyrula*, etc.) contain representatives of several widely distinct families. The references in such cases are to the families containing the typical species of such genera.

The monographs were generally published within a year of dates assigned to the volumes in which they were subsequently combined.

Vo	Year	Pl.	£.	s.	d.	Vol.	Year.	Pl.	£.	s.	d.
1	1843	131	8	10	6	10	1858	126	8	4	0
2	1843	114	7	9	0	11	1859	126	8	4	0
3	1845	130	8	9	0	12	1860	131	8	10	6
4	1847	110	7	4	0	13	1862	126	8	4	0
5	1849	147	9	10	6	14	1864	137	8	18	0
6	1851	129	8	8	0	15	1866	121	8	0	0
7	1854	210	13	15	0	16	1868	127	8	5	6
8	1855	153	9	18	0	17	1870	123			
9	1856	119	7	15	6						

The prices of separate monographs range from 1 sh. 6 d. per plate (1—2 pl.) and 1 sh. 4 d. (3—6 pl.) to little more than 1 sh. 3 d., according to the number of plates.]

CONTENTS.

Class A.—CEPHALOPODA.

Order I.—Dibranchiata.

Monograph of the genus.	Species.	Plates.	Volume.	Family.
Argonauta	5	4	12	4

Order II.—Tetrabranchiata.

Monograph of the genus.	Species.	Plates.	Volume.	Family.
Nautilus	5	6	12	19

Class B.—GASTEROPODA.

Sub-Class DIOECA.

Order III.—Pectinibranchiata.

Monograph of the genus.	Species.	Plates.	Volume.	Family.
Adamsiella	17	2	14	67
Ampullaria	134	28	10	72
Ancillaria	51	12	15	61
Anculotus	53	6	12	86
Buccinum	118	14	3	56
Bullia	26	4	3	57
Calyptræa	33	8	11	99
Cancellaria	86	18	10	48
Cassidaria	3	1	5	113
Cassis	33	12	5	113
Carithidea	29	4	15	90
Cerithium	149	20	15	90
Chondropoma	89	11	14	67
Columbella	240	37	11	65
Concholepas	2	2	14	64
Conus	333	56	1	43
Crepidula	30	5	11	99
Crucibulum	25	7	11	99
Cyclophorus	104	20	13	68
Cyclostoma	161	23	13	67
Cyclotus	59	9	14	68
Cymbium	18	26	13	52
Cypræa	154	27	3	106
Delphinula	27	5	1	130
Dolium	15	8	5	112
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Erato	18	3	15	107
Eulima	48	6	15	84
Fasciolaria	16	7	4	53
Ficula	4	1	4	111
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Halia	1	1	14	46
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Ianthina	25	5	11	116
Io	21	3	12	86

Monograph of the genus.	Species.	Plates.	Volume.	Family.
Lampania	10	2	15	90
Leiostraca	21	3	15	84
Leptopoma	51	8	13	67
Littorina	107	18	10	82
Mangelia	71	8	3	44
Marginella	159	27	15	51
Melania	473	59	12	88
Melanopsis	10	3	12	87
Melatoma	23	3	12	86
Mesalia and Eglisia	33	1	5	95
Meta	6	1	11	65
Mitra	334	39	2	54
Monoceros	15	4	3	64
Murex	194	37	3	64
Nassa	106	29	8	57
Natica	143	30	9	110
Niso	9	1	15	84
Oliva	99	30	6	61
Oniscia	6	1	5	113
Ovulum	66	14	15	105
Paludina	75	11	14	74
Paludomus	15	3	14	88
Phorus	9	3	1	101
Pirena	11	2	12	87
Pleurotoma	369	40	1	44
Potamides	2	1	15	90
Pterocera	10	6	6	102
Pterocyclos	30	5	14	68
Purpura	80	13	3	64
Pyramidella	45	6	15	83
Pyrazus	4	1	15	90
Pyrula	29	9	4	55
Ranella	50	8	2	114
Ricinula	54	6	3	64
Rostellaria	10	3	6	102
Sigaretus	26	5	15	110
Solarium	21	3	15	117
Strombus	56	19	6	102
Struthiolaria	4	1	6	103
Telescopium	2	1	15	90
Terebellum	1	1	14	102
Terebra	155	27	12	47
Triton	102	20	2	115
Trochita	15	3	11	99
Turbinella	73	13	4	59
Turritella	65	11	5	95
Tympanotonos	10	2	15	90
Umbrella	3	1	11	182
Vertagus	26	5	15	90
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Fissurella	122	16	6	136
Haliotis	73	17	3	134
Latia (With Navicella)	2	½	9	
Navicella	33	8	9	126
Nerita	85	19	9	126
Neritina	173	37	9	126
Phasianella	20	6	13	128
Scutus	5	2	17	137
Trochus	99	16	13	130
Tugalia	7	1	17	137
Turbo	63	13	4	128
Zizyphinus	65	8	14	130

Order VI.—Docoglossa.

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Chitonellus	7	1	4	143

Sub-Class PULMONIFERA.

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Achatinella	45	6	6	149
Anastoma	5	1	14	150
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Helix	1495	210	7	150
Partula	25	4	6	149
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Order IX.—Tectibranchiata.

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Aplysia	48	10	17	179
Atys	30	5	17	176
Bulla	19	6	16	176
Dolabella	6	2	16	179
Dolabrifera	7	1	16	179
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Order X.—Nudibranchiata.

No genera monographed.

Sub-Class PTEROPODA.

Order XI.—Thecosomata.

Order XII.—Gymnosomata.

No genera monographed.

Sub-Class PROSOPOCEPHALA.

Order XIII.—Solenoconcha.

No genera monographed.

Class C.—CONCHIFERA.

Order XIV.—Dimyaria.

Monograph of the genus.	Species.	Plates.	Volume.	Family.
Amphidesma	53	7	8	233
Anatina	30	4	14	228
Anodon	154	37	17	258
Arca	122	17	2	266
Artemis	61	10	6	238
Aspergillum	19	4	12	218
Capsa	2	1	10	235
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Cardita	50	9	1	257
Cardium	133	22	12	246
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Mesodesma	31	4	8	232
Myadora	10	1	2	227
Mycetopus	10	4	16	260
Myochama	4	1	12	229
Pectunculus	52	9	1	266

Monograph of the genus.	Species.	Plates.	Volume.	Family.
Pleiodon	2	1	16	259
Psammobia	59	8	10	235
Psammotella	7	1	16	235
Sanguinolaria	5	1	10	235
Soletellina	21	4	10	235
Tapes	75	13	14	238
Tellina	345	58	17	234
Thracia	22	8	12	228
Trigonia	4	1	12	263
Tngonia	6	1	14	225
Unio	525	96	16	258
Venne	141	26	14	238

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Hippopus	1	1	14	267
Tridacna	9	8	14	267

Order XVI.—Heteromyaria.

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Modiola	71	11	10	268
Mytilus	61	11	10	268

Order XVII.—Monomyaria.

Anomia	37	8	11	276
Avionla	75	18	10	276
Crenatula	8	2	11	270
Hemipecten	1	1	6	274
Hinnitee	2	1	8	274
Malleus	13	3	11	276
Pecten	176	35	8	274
Pedum	1	1	11	272
Perna	28	6	11	270
Pinna	66	34	11	269
Placnnanomia	14	3	11	276
Spondylue	68	18	9	272
Vnlsella	17	2	11	271

Order XVIII.—Rudista.

No genera monographed.

Sub-Branch MOLLUSCOIDEA.

CLASS D.—TUNICATA.

Order XIX.—Saccobranchia.

Order XX.—Dactylobranchia.

Order XXI.—Tæniobranchia.

Order XXII.—Larvalia.

No genera monographed.

CLASS E.—BRACHIOPODA.

Order XXIII.—Arthropomata.

Terebratula and Rhynchonella	51	11	13	299

Order XXIV.—Lyopomata.

Monograph of the genus.	Species.	Plates.	Volume.	Family.
Crania	4	1	13	307
Lingula	11	2	13	309
Orbicula	7	1	13	308

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INSTRUCTIONS

FOR OBSERVATIONS OF THUNDER STORMS.

1. Give the time of *beginning* and *ending* of the storm.
2. Give the general *direction of the approach* of the storm, or the point of the horizon where the storm cloud first appears.
3. Give the direction of the *wind* before, at the time of, and after the storm.
4. Note the color of the *lightning*, particularly if it be violet, which probably indicates a cloud of great elevation.
5. Does the *thunder cloud* frequently separate into two parts near your residence? If so, what is the topography of the surface of the earth below?
6. Record every instance of the *striking of trees and other objects*, and every accident by lightning in your vicinity.
7. Note the number of seconds the *sound* of a discharge continues this will give approximately the length of the flash.*
8. Note the time between the *appearance of the flash* and the *hearing of the thunder;* also the angle of elevation; these will give approximately the *height of the cloud.*
9. Note the *temperature* of the *air* before and after the storm.
10. Note the *depth* and *temperature* of the *rain* immediately after the storm.
11. Note whether any *hail* fell, how long it continued, the form and size of the hail-stones.

* The velocity of sound at the temperature of 62° is 1125 feet a second, or nearly a mile in $4\frac{7}{10}$ seconds.

JOSEPH HENRY,

Secretary of Smithsonian Institution.

SMITHSONIAN MISCELLANEOUS COLLECTIONS.

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CIRCULAR RELATIVE TO HEIGHTS.

For the purpose of forming a general map of the North American Continent, exhibiting the plains, mountains, valleys, etc., the Smithsonian Institution has collected a large amount of material relative to *altitudes*, which has been placed in the hands of W. L. Nicholson, Esq., Topographer of the U. S. Post-Office Department, to be discussed and elaborated.

There must, however, still remain in the hands of individuals and corporations, records of an important character, which would be of great value in properly carrying out the enterprise. It is, therefore, respectfully requested that printed copies, or original manuscripts of records, especially of plotted profiles or maps pertaining to this subject, be forwarded to the Smithsonian Institution.

In stating the heights, as furnished by surveys for railroads, whether actually constructed, or only projected, it is desirable that the levellings be referred to some known point on connecting or intersecting roads, or to the water-surface (high-water, low-water, or mean-tide) of the ocean, or of one of the great lakes, or to the level of a noted stage of water (high or low) of some river. The crossings of the watercourses, ridges, and summits are particularly desired, as well as all considerable and characteristic changes of level, giving, where much difference exists, both grade-line and original surface; the levels of all intersections with other roads are important as means of comparison, and for checking results.

Due credit will be given to all contributors to this work.

JOSEPH HENRY,
Secretary Smithsonian Institution.

Smithsonian Institution, Washington, D. C.

Form of Schedule for Record of Altitudes.

Name of Place.	County.	Location.			Dist. from	Height in ft. above	How determined.	Remarks.
		Sect	Tp.	Ran				

SMITHSONIAN MISCELLANEOUS COLLECTIONS.

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DIRECTIONS FOR CONSTRUCTING LIGHTNING-RODS.

FROM ESSAYS ON METEOROLOGY, BY PROF. JOSEPH HENRY.

1st. The rod should consist of round iron, of not less than three-fourths of an inch in diameter. A larger size is preferable to a smaller one. (Ordinary gas-pipe may be employed.) Iron is preferred, because it can be readily procured, is cheap, a sufficiently good conductor, and, when of the size mentioned, cannot be melted by a discharge from the clouds. Other forms of rod, such as flat or twisted, will conduct the lightning, and in most cases answer sufficiently well. They tend, however, to give off lateral sparks from the sharp edges at the moment of the passage of the electricity through them, which might, in some cases, set fire to very combustible materials.

2d. It should be, through its whole length, in perfect metallic continuity; as many pieces should be joined together by welding as practicable, and, when other joinings are unavoidable, they should be made by screwing the parts firmly together by a coupling ferule, care being taken to make the upper connection of the latter with the rod water-tight by cement, solder, or paint.

3d. To secure it from rust, the rod should be covered with a coating of black paint.

4th. It should be terminated above with a single point, the cone of which should not be too acute, and to preserve it from the weather, as well as to prevent its being melted, should be encased with platinum, formed by soldering a plate of this metal, not less than a twentieth of an inch in thickness, into the form of a hollow cone. Points of this kind can be purchased of almost any mathematical instrument maker. Usually the cone of platinum, for convenience, is first attached to a brass socket, which is secured on the top of the rod, and to this plan there is no objection. The platinum casing, however, is frequently made so thin, and the cone so slender, in order to save metal, that the point is melted by a powerful discharge.

5th. The shorter and more direct the rod is in its course to the earth the better. Acute angles, made by bending the rod, and projecting points along its course, should be avoided.

6th. It should be fastened to the house by iron eyes, and may be insulated by cylinders of glass. We do not think the latter, however, of much importance, since they soon become wet by water, and, in case of a heavy discharge, are burst asunder.

7th. The rod should be connected with the earth in the most perfect manner possible; and in cities nothing is better for this purpose than to unite it in good metallic contact with the gas-mains or large water-pipes in the streets; and, indeed, such a connection is absolutely necessary, if gas or water-pipes are within the house. Electricity, by what is called induction, acts at a distance on the perpendicular gas-pipes within a house, rendering them so highly negative, the cloud being positive, as to attract the electricity from a lightning-rod imperfectly connected with the earth, or even from the air through the roof. Damage to buildings on this account is of constant occurrence. The above connection can be made by soldering to the end of the rod a strip of copper, which, after being wrapped several times around the pipe, is permanently attached to it. When a connection with the ground cannot be formed in the way mentioned, the rod should terminate, if possible, in a well, always containing water; and, where this arrangement is not practicable, it should terminate in a plate of iron or some other metal buried in the moist ground. It should, before it descends to the earth, be bent, so as to pass off nearly at right angles to the side of the house, and be buried in a trench, surrounded with powdered charcoal.

8th. The rod should be placed, in preference, on the west side of the house, in this latitude, and especially on the chimney from which a current of heated air ascends during the summer season.

9th. In case of a small house, a single rod may suffice, provided its point be sufficiently high above the roof; the rule being observed, that its elevation should be at least half of the distance to which its protection is expected to extend. It is safer, however, particularly in modern houses, in which a large amount of iron enters into the construction, to make the distance between two rods less than this rule would indicate, rather than more. Indeed, we see no objection to an indefinite multiplication of rods to a house, provided they are all properly connected with the ground and with each other. A building entirely inclosed, as it were, in a case of iron rods so connected with the earth, would be safe from the direct action of the lightning.

10th. When a house is covered by a metallic roof, the latter should be united, in good metallic connection, with the lightning rods; and in this case the perpendicular pipes conveying the water from the gutters at the eaves may be made to act the part of rods, by soldering strips of copper to the metal roof and pipes above, and connecting them with the earth by plates of metal united by similar strips of copper to their lower ends; or, better, with the gas or water-pipes of the city. In this case, however, the chimneys would be unprotected, and copper lightning-rods soldered to the roof and rising a few feet above the chimneys, would suffice to receive the discharge. We say soldered to the roof, because, if the contact was not very perfect, a greater intensity of action would take place at this point, and the metal might be burnt through by the discharge, particularly if it were thin.

11th. As a general rule, large masses of metal within the building, particularly those which have perpendicular elevation, ought to be connected with the rod. The main portion of the great building erected for the World's Exhibition at Paris was entirely surrounded by a rod of iron, from which rose at intervals a series of lightning-conductors, the whole system being connected with the earth by means of four wells, one at each corner of the edifice.

The foregoing rules may serve as general guides for the erection of lightning-rods on ordinary buildings, but for the protection of a large complex structure, consisting of several parts, a special survey should be made, and the best form of protection devised which the peculiar circumstances of the case will admit.

SMITHSONIAN MISCELLANEOUS COLLECTIONS.

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QUERIES RELATIVE TO TORNADOES.

1. STATE the *localities* over which the storm extended—in the new States, trace the route on the quarter-sections of the U. S. Land Surveys.

2. State the *date* of the occurrence of the storm, and the *precise time of day* (or height of sun) of its passing over different places.

3. State the *width of the track* at different places, specifying how wide that portion of it was where the most violent effect was produced; and what was the nature of this *effect on the surface of the ground*—for example, was the surface beaten flat, or was it furrowed.

4. Give the shape, color, and velocity of the *storm-cloud*, and also the general appearance of the *clouds in other parts of the sky*, previous to, and at the immediate passage of the Tornado.

State whether some of these clouds were of a (dull) grayish color, while others were of a (bright) white color:—whether these *differently colored clouds* were in opposite parts of the sky—or whether they were in two distinct layers, one above the other—what was the *color of the layer* (or stratum) *which was the higher*—how did they appear to be moving—*towards* or *away from* each other—and how did the *lightning*, if any, appear to *pass from them*—to each other, or to the earth.

5. State the direction and force of the *wind*, before and after the passage of the Tornado—and whether it blew steady or in gusts.

6. Describe the *thunder and lightning* observed:—whether the thunder was sudden or prolonged—and the lightning, whether zigzag, forked, or sheet—and what was its color.

7. Was there accompanying *rain, or hail*, immediately in the

main track of the Tornado—and was there any at a distance—if so, how far off, on each side of the track.

8. Was the *day unusually warm, sultry, or not*:—were there observed any effects of a *superabundance of moisture* in the atmosphere—such as deposition on walls and on furniture in basements and other cool places, rendering them wet or clammy to the touch.

9. State the *character of the weather* for some time preceding and following the storm—and, particularly for the few days immediately preceding:—whether it was *dry* or *wet*, *warm* or *cool*.

On the day of the Tornado, was anything unusual observed in the *aspect of the sky*—any lurid, "brassy" hue—and if so, how long did it last.

10. Give the *damage done to life and property*:—full *statistics* of this, between specified points of the course of the storm, are desirable.

11. State the manner and direction in which the *walls and roofs of buildings* appear to have been struck, and to have fallen, or to have been carried away:—whether portions of buildings were *twisted around* upon their foundations—and whether, in the case of some buildings where the doors and windows are known to have been closed at the time of the storm's passage, the walls or roof were thrown down, *as if by an explosion outwards*. Careful *sketch drawings* of any of the appearances will be valuable.

12. Give any cases of the *stripping of feathers* from fowls, and the *clothes from persons*:—also the manner in which *furniture and materials* of houses, barns, &c., were *destroyed or carried off*, and in what *direction*, and to what *distance*.

13. Did any of the persons in the immediate vicinity of the Tornado, at its passage, experience any peculiar sensations:—any *shock*, *numbness in the limbs*, *loss of hearing*, *peculiar smell*, *feeling of cold*, *&c.*, *&c.*—and how long did these effects last.

14. Was anything unusual perceived in regard to the *wounds* of the persons or animals injured: were they difficult to heal, and was there anything unusual in the appearance of the bodies of the killed.

15. State any facts observed as to the *direction* in which the

trees were thrown down, or *broken off*, on the *north*, and on the *south* side of the track.

16. What *effects* were produced *on the trees*—whether *broken off at the trunk*, *uprooted*, or *twisted around*—or *separated into splinters:* did the *sap remain* in the wood, or was it *dried up* or evaporated :—what effect was produced on the *bark*, and what on the *branches and leaves:*—did any of the *leaves* present the appearance of having been *scorched*.

Did any particular trees that stood in the track appear to have *escaped the destructive action*—if so, *what kind of trees* were these.

17. Were there any well-authenticated instances of *hay*, *straw*, or *grain-stacks*, or *stables*, or *other buildings* having been *set on fire by the lightning*, during the passage of the storm.

18. Was any case noticed of *iron* or *steel* which exhibited *marks of heating* or of *mechanical action*—if so, describe the appearance.

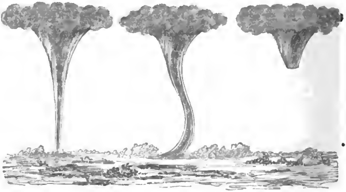
19. Were there any *side-currents towards*, or *offshoots from* the main course of the Tornado :—and where did these commence and terminate.

20. State what was observed in regard to the *whirl of the Spout* or funnel-shaped cloud :—the direction of its rotation on its axis, whether "with the sun," that is, in the direction of the hands of a watch when placed face upward—or "against the sun," that is, opposite to that of the hands of a watch.

21. What was the *color* and *general appearance of the Spout :* was it always *in contact* with the ground, or did it sometimes rise up and again descend :—was it *perpendicular* or nearly so to the earth's surface, or was it *curved* or *inclined* in the whole or part of its length, and in which direction :—was it of *uniform diameter* or varying :—what was its *apparent height* as compared with buildings, trees, or other objects passed over—and how did it seem to be *connected with the clouds* above it.

If *more than one Spout* was in sight at the same time, describe their relative appearances and motions.

A *sketch* (however rough, if accurate) of the appearance of the Spout will be valuable, as also of its *changes in figure*, as it moved onward—thus :—



22. Were branches, limbs, or trunks of trees, articles of clothing, pieces of furniture or of wagons, or of houses *observed carried up in the Spout*—if so, how did they *appear to be moving*—*how high* and *how far* did they go—and in what manner were they *dropped*, whether gently or with violence.

23. Was the *onward speed of the Spout* uniform, or observed to vary :—did the *track* it left on the surface of the ground *spread out* or *contract in width* at different parts of its course, particularly near rivers and creeks :—and what effects were observed to be produced on surfaces of *water*, while it was passing over them.

24. Did any *detached clouds* appear to move *towards the Spout* —in what manner did they join it—did they increase its dimensions, or did they appear to be condensed in it.

Did any clouds appear to *move off from* the Spout.

25. Was any *lightning* observed *in the Spout itself*, as well as in the accompanying main storm-cloud, from which the Spout usually is seen to hang down.

What was the *character of this lightning*—was it a glow of light—a discharge along the length of the Spout—or transverse —or was it globular in appearance.

☞ *Brief answers to even a part of these queries, sent to the Smithsonian Institution, Washington, D. C., may be of importance, and will be thankfully acknowledged.*

SMITHSONIAN MISCELLANEOUS COLLECTIONS.

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QUESTIONS RELATIVE

TO THE

FOOD FISHES OF THE UNITED STATES.

A. NAME.

1. What is the name by which this fish is known in your neighborhood? If possible, make an outline sketch for better identification.

B. DISTRIBUTION.

2. Is it found throughout the year, or only during a certain time; and for what time?

3. If resident, is it more abundant at certain times of the year; and at what times?

C. ABUNDANCE.

4. How abundant is it, compared with other fish?

5. Has the abundance of the fish diminished or increased within the last ten years, or is it about the same?

6. If diminished or increased, what is the supposed cause?

7. What is the amount, or extent, of the change in abundance?

D. SIZE.

8. What is the greatest size to which it attains (both length and weight), and what the average?

9. State the rate of growth, per annum, if known; and the size at one: two: three: or more years.

10. Do the sexes differ in respect to shape, size, rate of growth, etc. ?

E. MIGRATIONS AND MOVEMENTS.

11. By what route do these fish come in to the shore; and what the subsequent movements ?

12. By what route do they leave the coast ?

13. Where do they spend the winter season ?

14. When are the fish first seen or known to come near the shore, and when does the main body arrive; are the first the largest · are there more schools or runs than one coming in, and at what intervals ?

15. When do the fish leave shore, and is this done by degrees, or in a body ?

16. Is the appearance of the fish on the coast regular and certain, or do they ever fail for one or more seasons at a time, and then return in greater or less abundance? If so, to what cause is this assigned ?

17. How do the runs differ from each other in number and size ?

18. Which sex comes in first; and how far advanced is the spawn in the female on first arriving ?

19. Will either sex, or both, take the hook on first arriving ; and if so, is there any period of the stay of the fish when they refuse it ?

20. If they refuse the hook at first, how soon do they begin to take it after arriving ?

21. Do the schools of fish swim high or low; and is their arrival known otherwise than by their capture; that is, do they make a ripple on the water: do they attract birds, etc ?

22 What is the relation of their movements to the ebb and flow of the tide ?

23. Does spawn ever run out of these fish taken with a hook ?

24. Answer same question in regard to fish taken in nets or pounds; is the spawn ever seen in any quantity floating about inside of nets?

25. Are these fish anadromous; that is, do they run up from the sea into fresh water for any, and for what purpose?

26. If anadromous, when are they first seen off the coast; when do they enter the mouths of the rivers, and what is the rate of progression up stream?

27. If anadromous, what the length of their stay in fresh water, and when do they return to the sea?

28. Do the different sexes or ages vary in this respect?

29. Do these fish come on to the breeding grounds before they are mature: or do you find the one or two year old fish with the oldest?

30. What are the favorite localities of these fish; say whether in still water or currents; shallow or deep water; on the sand; in grass; about rocks, etc.?

31. What depth of water is preferred by these fish?

32. What the favorite temperature and general character of water?

F. Relationships.

33 Do these fish go in schools after they have done spawning: or throughout the year; or are they scattered and solitary?

34 Have they any special friends or enemies?

35 To what extent do they prey on other fish; and on what species?

36 To what extent do they suffer from the attacks of other fish: or other animals?

G. Food.

37. What is the nature of their food?

38. Are there any special peculiarities in the manner of feeding of these fish?

39. What amount of food do they consume?

H. Reproduction.

40. Is there any marked change in the shape or color of either sex during the breeding season; or any peculiar development of, or on any portion of the body, as the mouth, fins, scales, etc.?

41. Are there any special or unusual habits during the spawning season?

42. Is spawning interfered with by lines or nets, or otherwise?

43. At what age does the male begin to breed; and at what age the female?

44. For how many years can these fish spawn?

45. Does the act of spawning exert an injurious effect?

46. Where do these fish spawn, and when?

47. Can you give any account of the process: whether males and females go in pairs, or one female and two males: whether the sexes are mixed indiscriminately, etc.?

48. Is the water ever whitened or colored by the milt of the male?

49. What temperature of water is most favorable for hatching?

50. At what depth of water are the eggs laid, if on, or near the bottom?

51. What is the size and color of the spawn?

52. What is the estimated number for each fish; and how ascertained?

53. Answer the question for one season, and for the lifetime?

54. Do the eggs, when spawned, sink to the bottom, and become attached to stones, grass, etc., or do they float in the water until hatched?

55. Do the fish heap up or construct any kind of nest, whether

of sand, gravel, grass, or otherwise; and if so, is the mouth, the snout, or the tail used for the purpose, or what; and if so, how is the material transported; or do they make any excavation in the sand or gravel?

56. Do they watch over their nest, if made, either singly or in pairs?

57. When are the eggs hatched, and in what period of time after being laid?

58. What percentage of eggs laid is usually hatched?

59. What percentage of young attains to maturity?

60. What is the rate of growth?

61. Do the parents, either or both, watch over the young after they are hatched?

62. Do they carry them in the mouth, or otherwise?

63. What enemies interfere with, or destroy, the spawn or the young fish? Do the parent fish devour them?

64. Are the young of this fish found in abundance, and in what localities?

65. On what do they appear to feed?

I. Artificial Culture.

66. Have any steps been taken to increase the abundance of this fish by artificial breeding?

K. Protection.

67. Are these fish protected by law, or otherwise?

L. Diseases.

68. Has any epidemic, or other disease, ever been noticed among them, such as to cause their sickness or death in greater or less number?

69. When have these epidemics taken place, and to what causes have they been assigned?

M. PARASITES.

70. Are crabs: worms: lampreys, or other living animals, found attached to the outside, or on the gills of these fish?

N. CAPTURE.

71. How is this fish caught; if with a hook, what are the different kinds of bait used, and which are preferred?

72. If in nets, in what kind?

73. At what season and for what period is it taken in nets, and when with the line?

74. What would be the average daily catch, of one person, with the hook, and what the total for the season?

75. Answer the same question for one seine, or pound, of specified length.

76. Is the time of catching with nets, or pounds, different from that with lines?

77. Is it caught more on one time of tide than on another?

O. ECONOMICAL VALUE AND APPLICATION.

78. What disposition is made of the fish caught, whether used on the spot; or sent elsewhere, and if so, where?

79. What is its excellence as food, fresh or salted?

80. How long does it retain its excellence as a fresh fish?

81. To what extent is it eaten?

82. Is it salted down, and to what extent?

83. Is it used, and to what extent, as manure, for oil, or for other purposes, and what?

84. What were the highest and lowest prices of the fish, per lb., during the past season, wholesale and retail, and what the average, and how do these compare with former prices?

85. Are these fish exported; and if so, to what extent?

86. Where is the principal market of these fish?

87. NAME OF AND ADDRESS OF OBSERVER.

88. DATE OF STATEMENT.

MEMORANDA OF INQUIRY

RELATIVE TO THE

FOOD FISHES OF THE UNITED STATES.

A. Name of Fish in different localities.

B. Geographical distribution.
  - At present time.
    - Change of location with season of year.
  - In former times.
    - Supposed cause of any permanent change.

C. Abundance.
  - At present time: in different seasons and localities.
  - In former times: in different seasons and localities.
  - Supposed cause of variation in abundance.
  - Probable change in the future.

D. Size.
  - Maximum length and weight.
  - Average length and weight.
  - Rate of growth.
  - Length and weight at age of one: two: three: etc., years.
  - Difference of sexes in this respect.

E. Migrations and movements.

Arrival and departure.

Period of stay.

Certainty of arrival.

Route of movement, coming and going.

Number and times of runs or schools in one season, and differences if any in the runs.

Difference in arrival of the sexes and ages.

Feeding of fish after arrival.

Summer abode.

Winter abode.

If anadromous: when entering the fresh water and when leaving.

If anadromous: what the movements up and down fresh waters, of adults, or of young.

Rate of progression of schools in fresh or salt water.

Relation of movements to tides.

Depth of water preferred by schools or single fish.

Temperature and general condition of water preferred.

Favorite localities in any region; whether bottom be sandy, rocky, muddy, grassy, etc.

F. Relationships.

To its own species: whether gregarious, solitary, grouped by age or sex at any season, predaceous, etc.

To other animals: whether preyed upon by them, feeding upon them, etc.

Special enemies: friends: or companions.

G. Food.

Nature.

Mode of taking it.

Time of taking it.

Quantity consumed.

II. Reproduction

Interference with spawning, by lines, nets, etc.

Age of male and of female respectively, when capable of reproduction.

Change in physical condition (color, shape, fatness, etc.).

Date of spawning, and its duration as relating to the individual as well as to the species.

Preferred localities for spawning, as to place, temperature, etc.

Special habits during spawning season.

Special habits before or after spawning.

Ratio of mortality in old fish from spawning.

Number of successive years of capacity for spawning.

Nesting places.

Are nesting places prepared? if so, whether of grass, stones, sand, etc., or cleared areas, and whether made by one sex only, or both?

If ridges or furrows are formed, how made.

The eggs.

Mode of fecundation.

Where laid.

Where and how attached, if at all.

Covered up, and how, or exposed in water.

Number laid by one fish at one time, and the number during lifetime.

Size and color

Special enemies.

Guarding of eggs by either sex.

- The embryo and young fish.
  - Ratio of fish hatched to number of eggs laid.
  - Proportion of young fish attaining maturity.
  - Movement after birth: whether remaining on spawning ground, and how long; or whether changing from fresh to salt, or salt to fresh water, etc., and when.
  - General appearance, and successive changes.
  - Rate of growth.
  - Special food.
  - Enemies and diseases of eggs and young.
  - Relation of parent fish, of either sex, to young: whether protective, predatory, etc.

I. Diseases.

K. Parasites.

L. Artificial fish-culture.

M. Protection by law.

N. Capture.

- Methods.
  - By lines.
  - By nets.
    - Floating, or movable (seines, gill-nets, etc.).
    - Fixed (traps, pounds, weirs, dams, etc.).
  - Other methods of capture.
  - Bait.
  - Influence of modes of capture on abundance.
- Season of capture.
  - By lines.
  - By nets.
  - Otherwise.